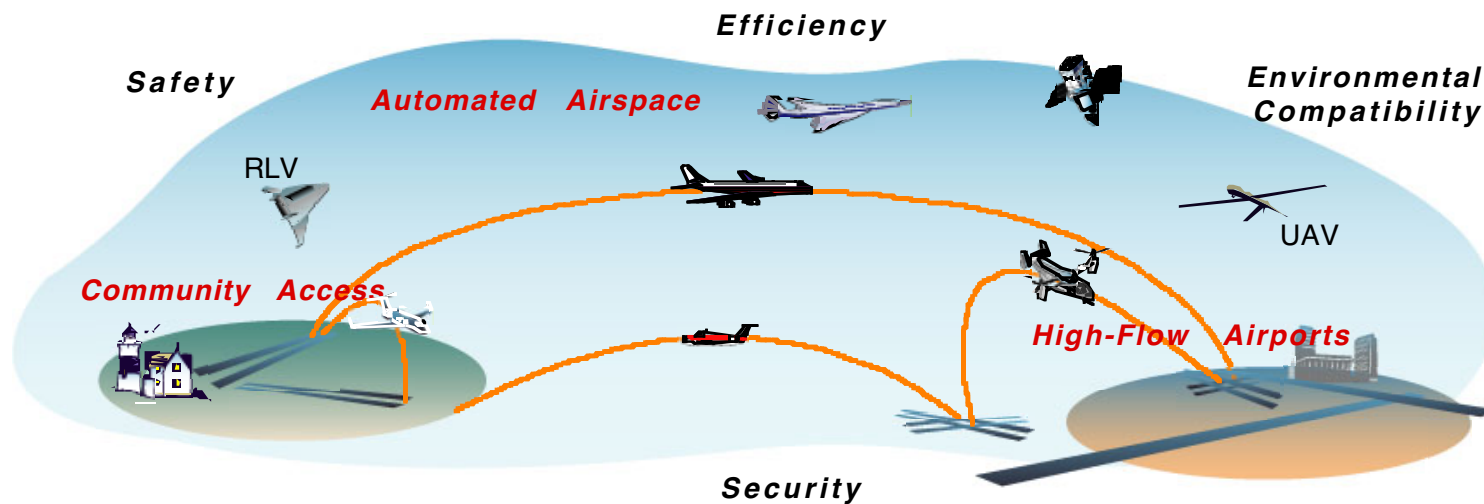


VIRTUAL AIRSPACE MODELING AND SIMULATION PROJECT

Technical Interchange Meeting III



Harry N. Swenson
Project Manager
NASA Ames Research Center

January 14-15, 2003

The **Goal** of the VAMS Project is to develop capabilities that lead to a significantly increase in the capacity of the National Airspace System, while maintaining safety and affordability.

The VAMS **Objectives** are:

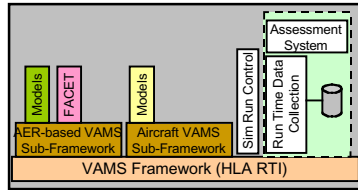
- To define potential operational concepts.
- To generate supporting technology roadmaps.
- To establish the capability to assess these concepts.

- **Evaluated advance airspace system concept(s).**
 - **Interim evaluations at domain and system level.**
- **Technology roadmap(s) to implement proposed concept(s).**
 - **Annual updates of roadmaps at domain or system level.**
- **Validated modeling and simulation capability to assess new operational concepts at the domain and system-wide level.**
 - **Annual builds of non-real-time modeling and simulation capability.**
 - **Annual updates of real-time simulation capability.**

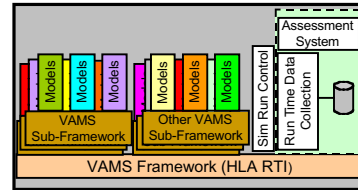
Approach

Virtual Airspace Modeling & Simulation - TIM III

Existing Models



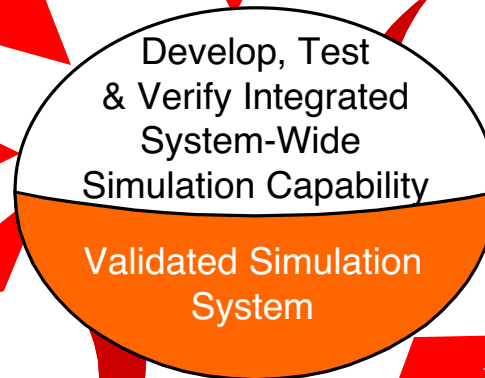
Improved Models



Set of Operational Concepts



Develop New Concepts



Validation

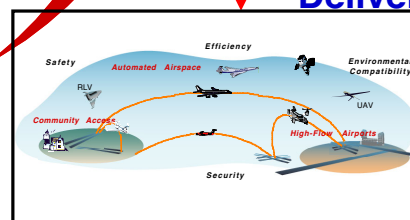
Deliverable

Deliverable

Baseline

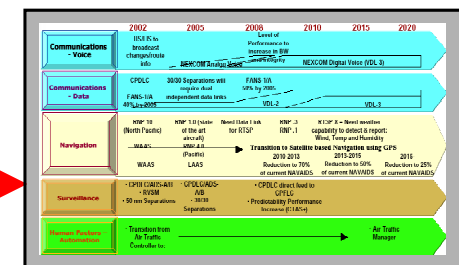


Scenarios & Metrics



Evaluated & Assessed Revolutionary Operational Concepts

Deliverable



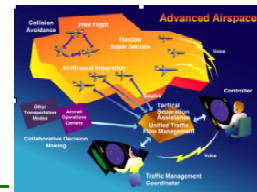
Technology Roadmaps

Operational Concepts Identified

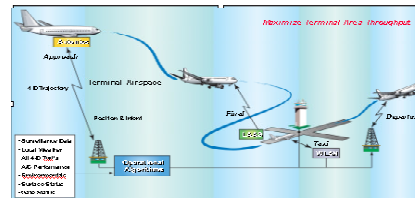
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System-level

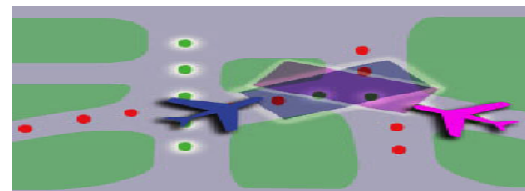
Boeing - ATM Concept
 Metron - Weather
 Seagull - Massive PTP
 University Concept
 NASA ARC - System-wide Optimization
 FAA/RTCA - Future ATM Concept
 NASA LaRC - Small Air Transportation System



NASA ARC - Advanced Airspace
 NASA LaRC/ARC - Dist. Air Ground



NASA LaRC - Wake Avoidance
 Raytheon - Terminal Area Concept
 Northrop Grumman - Centralized Terminal



Metron - Surface Traffic Automation
 Optimal Synthesis - Surface Operation Automation

En route

Terminal

Surface

climb

descent

takeoff

landing

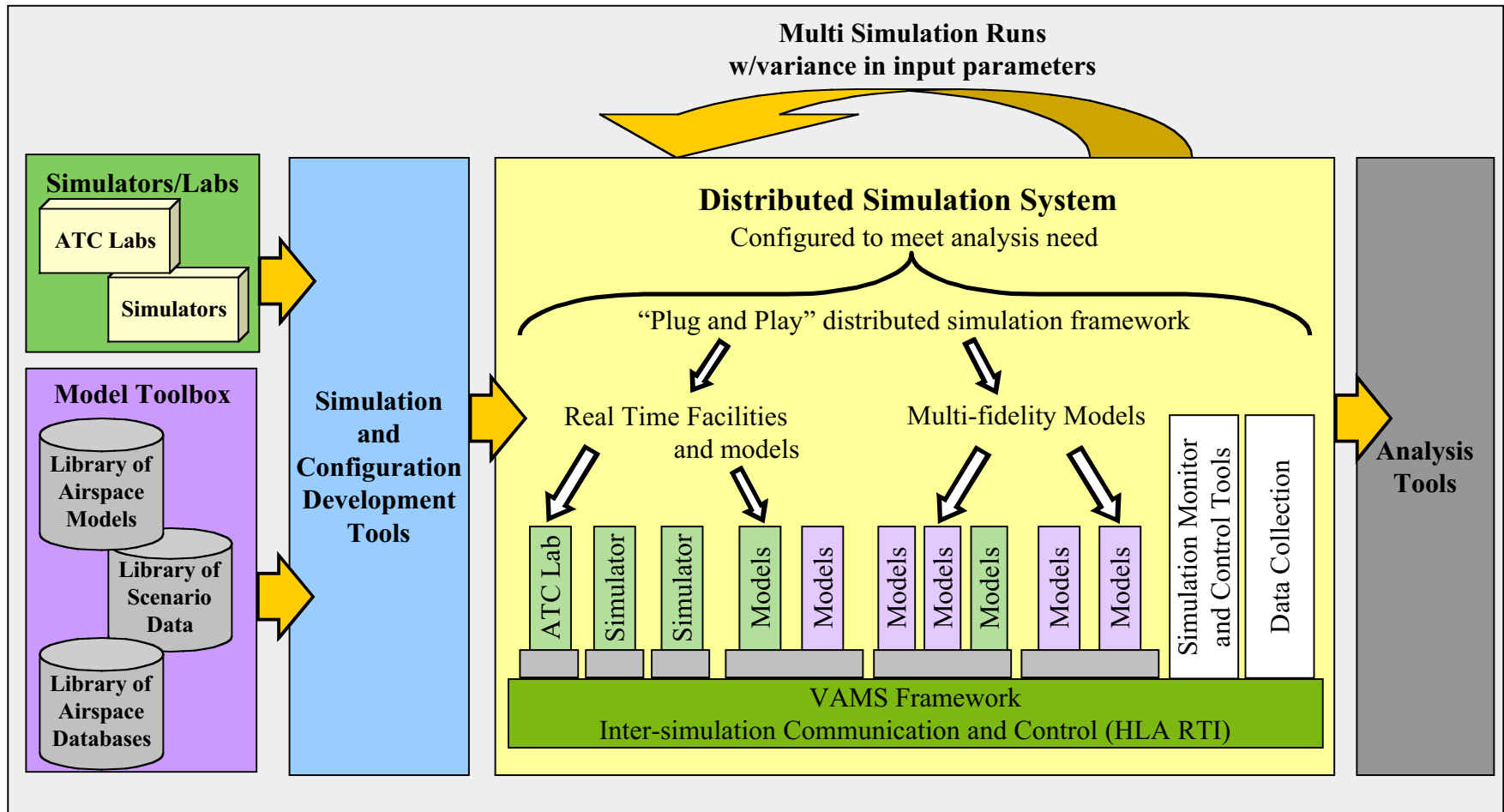
taxi

taxi

gate

gate

Modeling and Simulation Description





Non-Real-Time System-Level Modeling and Simulation System Accomplishments



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- **April 2002:** Demonstrated a proof-of-concept prototype.

- Selected the DoD's HLA-RTI infrastructure with agent-based software to enable fast-time NAS-wide simulation
- Established a modeling lab that leverages existing and emerging models and tools

- **February 2003:** Proving the feasibility of the approach to capture the interactions between NAS entities.

- The baseline system, Build-1 provides:

- Architectural foundation

- Creates an agent infrastructure
- Develops a robust HLA framework

- Basic modeling toolbox

- Emulates the current NAS
- Simulates NAS-wide, gate-to-gate at low-resolution
- Models entire day-in-the-NAS scenario
- Some emphasis on modeling TFM interactions

- Assessments

- Measure delay (gate, taxi, airborne)
- Fuel costs
- Controller workload (# of vectors, speed changes, # TFM restrictions, CD&R activity)
- TFM activity

- Five software tests have been completed; each verifies a key feature of the simulation system.



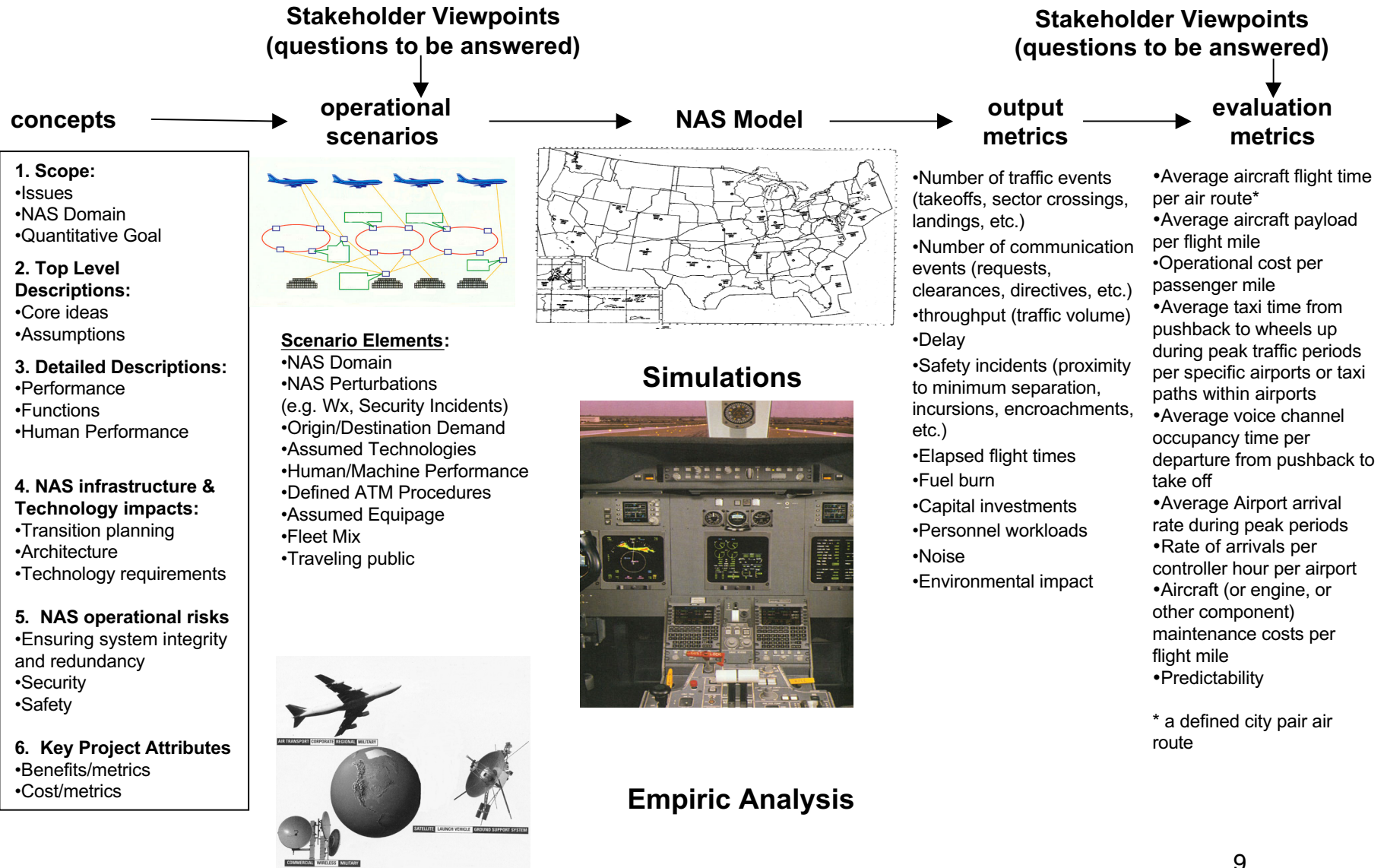


Real-Time Modeling and Simulation System Accomplishments



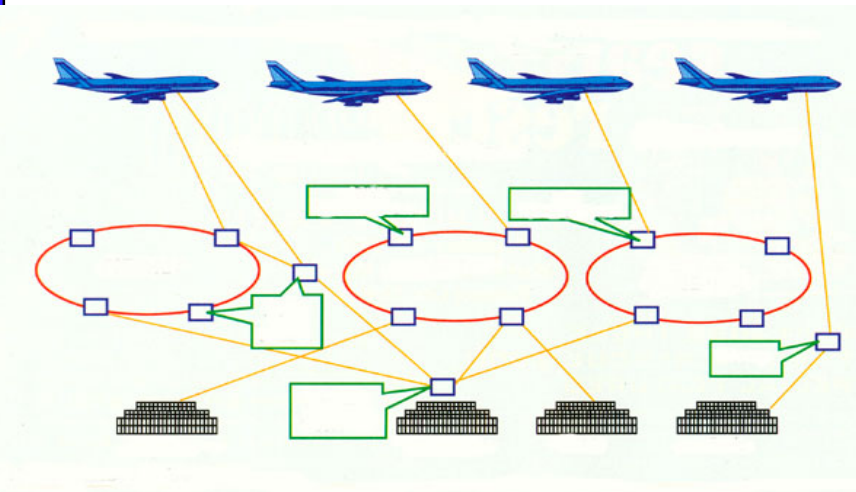
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- **August 2002:** Conducted Preliminary Design Review (PDR.)
 - Selected the DoD's HLA-RTI infrastructure with agent-based software
 - Established a series of progressive Interim Tests to prove and deliver incremental operational simulation capabilities to the Project
- **November 2003:** Interim Test #1 provides the functionality approved in the PDR and establishes a firm baseline configuration for building the remainder of the VAST-RT simulation system,
 - The baseline system, Build-1 provides:
 - Architectural foundation
 - HLA based infrastructure
 - Robust multi-simulator capability
 - Version 1 of the data communication toolbox
 - Emulates the current legacy systems
 - Provides enhanced communications capabilities
 - Four test scenarios have been completed; each verifying a key feature of the simulation system.

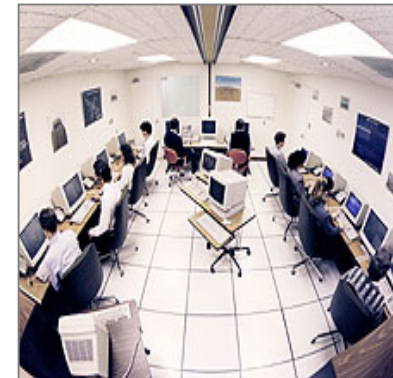
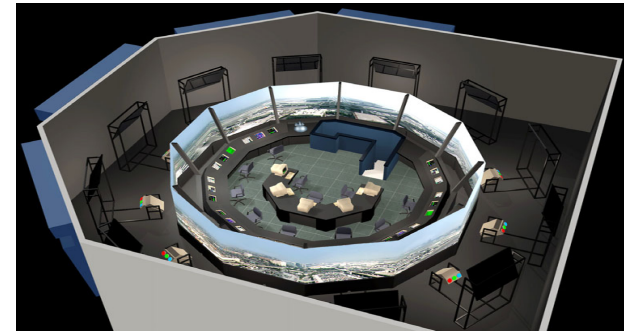


Evaluation and Assessment Accomplishments

Develop Methods & Requirements

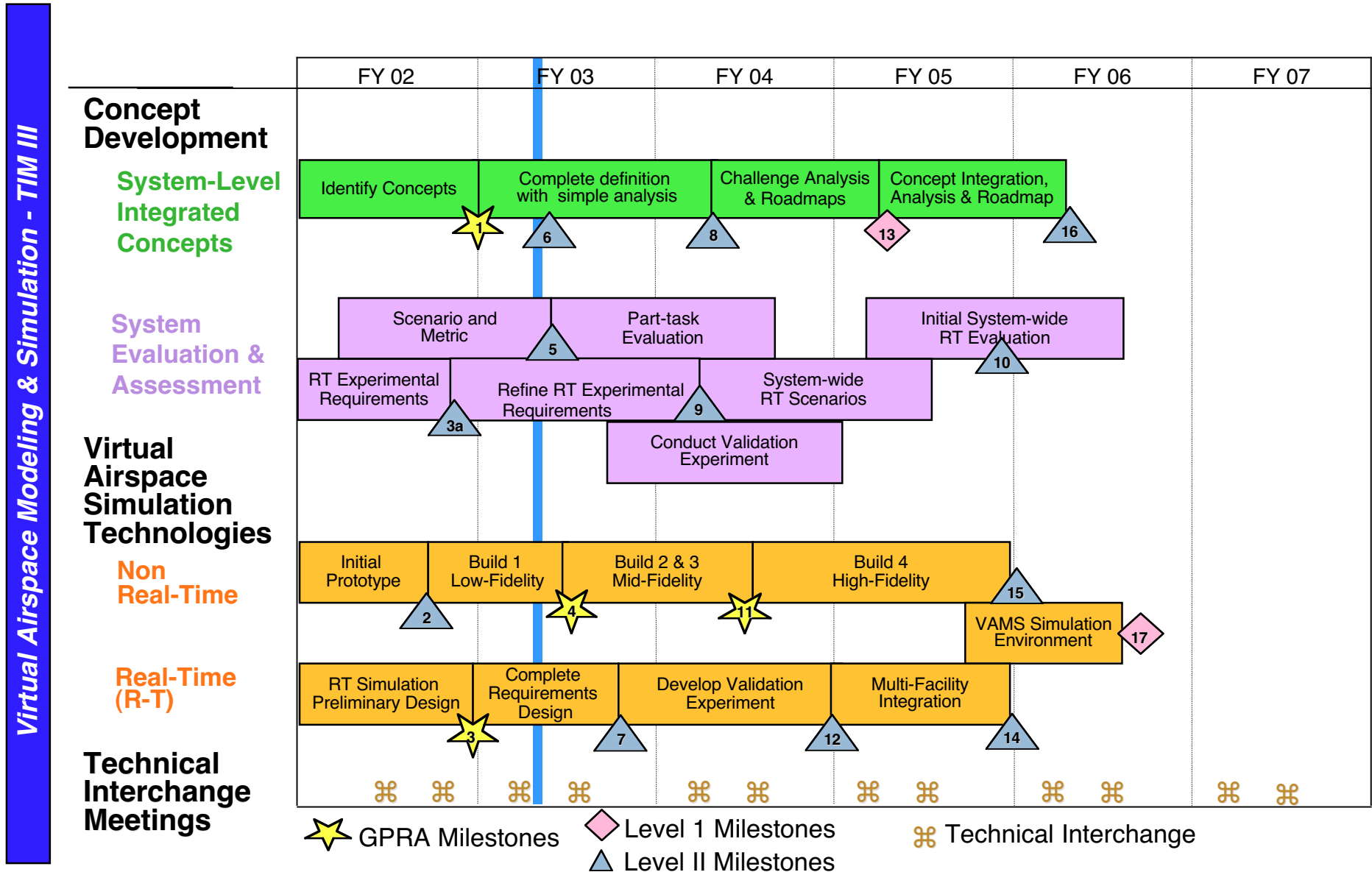


- Requirements to support validation of the real-time capabilities
 - Facility requirements
 - Data collection requirements
 - Software agent requirements
- Delivered 6/28/02



Evaluation and Assessment Accomplishments

- **Economic Forecast and Demand (GRA,LMI)**
 - **Scenario Planning**
 - **GDP Growth (H/L), Airline Yields (H/L), Limits to Aviation System Growth (Many/Few), Substitutes to Commercial Air Travel (Good/Poor)**
 - **Five Scenarios pursued**
- **Non-Real Time Scenario and Metrics (VAMS Common Scenario Set)**
 - **Concept Analysis**
 - **Storyboards**
 - **Data Sources**
 - **Dependent Variables**
 - **Scenario Element Breakdown**
 - **Dependent Variable Calculations**





Project Milestones



Virtual Airspace Modeling & Simulation - TIM III

- | | | |
|----|--|----------|
| 1 | "Identify candidate future ATS capacity-increasing operational concepts" | 09/30/02 |
| 2 | "Develop initial prototype VAST NRT airspace model toolbox w/system-level capabilities" | 04/30/02 |
| 3A | "Complete definition of Initial Real-Time experimental requirements" | 06/28/02 |
| 3 | "Complete VAST RT environments definitions and preliminary design" | 09/30/02 |
| 4 | "Complete Build 1 VAST NRT state-of-the-art airspace models toolbox with the ability to assess economic impact of new technology and NAS operational performance and the ability to model the dynamic effects of interactive agents" | 12/31/02 |
| 5 | "Complete preliminary description of common scenario set & evaluation criteria for operational concept assessment" | 01/01/03 |
| 6 | "Complete operational concept and roadmaps for introducing Wake vortex avoidance into the Air Transportation System" | 01/15/03 |
| 7 | "Complete VAST Real-Time requirements and initial design" | 06/30/03 |
| 8 | "Complete self-evaluation of concepts and roadmaps" | 02/13/04 |
| 9 | "Complete definition of initial VAST Real-Time experiments" | 04/30/04 |
| 10 | "Complete preliminary evaluation of selected operational concepts (RT only)" | 09/01/05 |
| 11 | "Complete Build 3 VAST NRT toolbox with cognitive human performance attributes and CNS models" | 08/30/04 |
| 12 | "Complete verification of initial VAST RT capabilities against an AATT derived operational concept" | 09/30/04 |
| 13 | "Complete analysis and of capacity-increasing concepts and roadmaps w/VAST models, simulations & Common Scenario Set" | 12/15/04 |
| 14 | "Complete verification of VAST Real-Time Multi-Facility capabilities" | 06/30/05 |
| 15 | "Complete Build 4 VAST NRT toolbox for advanced operational concept analysis " | 09/30/05 |
| 16 | "Complete definition and analysis of single system-level operational concept and roadmap" | 03/30/06 |
| 17 | "Complete development of RT/NRT VAST simulation and modeling tools for Air Transportation System technology development" | 06/30/06 |

